Product Features

Operating Frequency range: 50MHz ~ 10GHz

Attenuation Range: 0.5dB LSB Steps to 31.5dB

Insertion Loss: 1.6dB@1GHz

Input Power for 1dB Compression: +30.5dBm@1GHz

Relative Phase at 16 dB Attenuation State: 0.5°@1GHz

Supply current 2mA @ Vdd=5V

Package: QFN24 (4mm×4mm)

General Description

The BR9363FPJ is a 6-bit low-relative-phase digital attenuator. Covering a frequency band of 50MHz~10GHz, the BR9363FPJ typically offers insertion loss of less than 3.2dB, and can be programmed to provide an attenuation range of 31.5dB in 0.5dB steps with the typical relative phase value of ±5°. 6-bit TTL/CMOS control inputs are used to select each attenuation state.

Application

Communication Base Stations

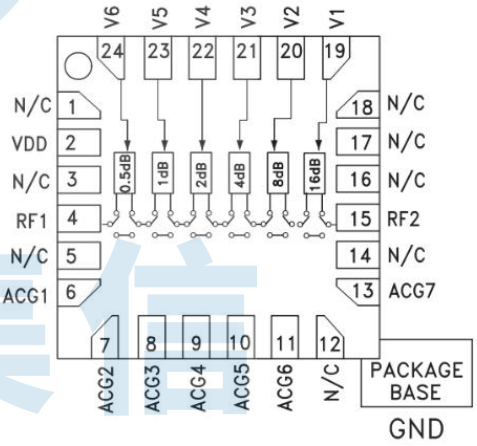
Phased Array Radar

Electronic Countermeasures

Remote Sensing and Telemetry

Ultrashort-Wave Wireless Communication Equipment

Functional Block Diagram



Ordering Information

Part Number	Package	Description
BR9363FPJ	QFN24	50MHz ~ 10GHz 6-Bit Digital Attenuator

Electrical Specifications

Parameter	Test Conditions	Min.	Typ.	Max.	Units
Insertion Loss	0.05GHz to 10.0GHz	-3.2	-1.6	-1.2	dB
Attenuation Range	0.05GHz to 10.0GHz	0.5	-	31.5	dB
Input Return Loss	0.05GHz to 10.0GHz	-	-19.7	-	dB
Output Return Loss	0.05GHz to 10.0GHz	-	-18.6	-	dB
Attenuation Accuracy (reference state insertion loss): All attenuated states	0.05GHz to 1.0GHz	-0.10	-	1.62	dB
	1.0GHz to 4.0GHz	-0.15	-	1.24	
	4.0GHz to 10.0GHz	-0.20	-	1.32	
Relative Phase (Reference state insertion loss): All attenuated states	0.05GHz to 4GHz	-2.94	-	1.68	°
	4.0GHz to 10.0GHz	-15.95	-	2.87	
Input Power for 1dB Compression	0.05GHz to 6GHz	17.2	30.5	30.6	dBm
Input Third-Order Interception	1GHz to 6GHz	39.8	44.4	47.1	dBm
Switching Characteristics Trise (50% CTL-90% RF) Tfall (50% CTL-10% RF)	200MHz at 16dB Attenuation State	- -	51 42	- -	ns
Test Conditions: Vdd=+5V, I=2mA, Input IP3 spacing=1MHz, Pin=10dBm/tone, Temp=+25°C					

Absolute Maximum Ratings

Maximum Operating Voltage (Vdd): +7V

Max RF input Power: +30dBm@100MHz

Control Voltage Range: 0V ~ Vdd

Recommended Operating Conditions

Supply Voltage: +5V

Supply Current: 2mA

Control Voltage Threshold:

0 ~ 1.2V (low level)

1.5V ~ Vdd (high level)

Storage Temperature: -65℃ ~ +150℃

Operating Temperature: -55℃ ~ +125℃

Note: Operation of the device outside the parameter ranges given absolute-maximum-ratings conditions may cause permanent damage, and exposure to absolute-maximum-ratings conditions for extended periods will affect the reliability.

ESD WARNING

ELECTROSTATIC SENSITIVE DEVICE

OBSERVE HANDLING PRECAUTIONS

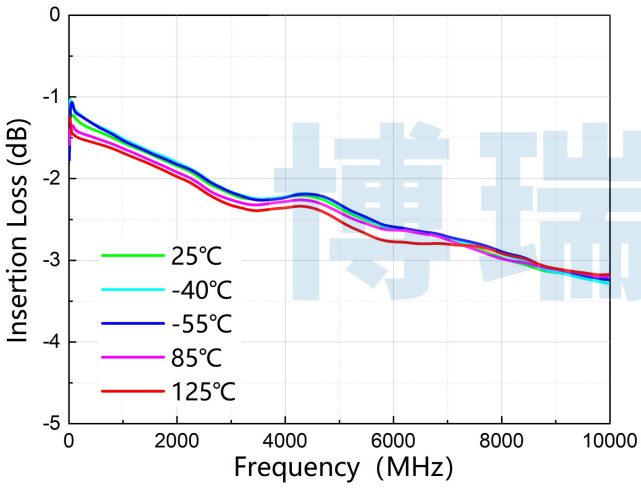
Typical Performance (EVB test results)

Parameter	Typ.						Units
Frequency	**50**	**200**	**600**	**1200**	**1600**	**2000**	**MHz**
Reference state Insertion Loss	-1.3	-1.3	-1.4	-1.6	-1.7	-1.9	dB
Attenuation Accuracy (0.5dB)	0.04	0.01	0.01	0.01	0.01	0.01	dB
Attenuation Accuracy (1 dB)	-0.03	-0.03	0.01	-0.03	-0.02	-0.02	dB
Attenuation Accuracy (2 dB)	0.01	-0.08	-0.07	-0.07	-0.06	-0.06	dB
Attenuation Accuracy (4 dB)	-0.01	-0.08	-0.09	-0.10	-0.10	-0.09	dB
Attenuation Accuracy (8 dB)	0.41	0.46	0.41	0.39	0.40	0.39	dB
Attenuation Accuracy (16 dB)	0.57	0.67	0.65	0.66	0.73	0.75	dB
Attenuation Accuracy (31.5dB)	1.14	1.45	1.36	1.13	1.17	1.18	dB
Relative Phase (0.5dB)	0.08	-0.07	-0.05	-0.22	-0.27	-0.42	°
Relative Phase (1 dB)	0.09	0.08	-0.02	-0.31	-0.33	-0.50	°
Relative Phase (2 dB)	0.00	0.00	0.00	-0.10	-0.09	-0.14	°
Relative Phase (4 dB)	-0.29	-0.14	0.04	0.14	0.23	0.40	°
Relative Phase (8 dB)	0.19	0.15	-0.61	-0.93	-1.08	-1.47	°
Relative Phase (16 dB)	0.55	0.90	-0.08	0.52	0.68	0.32	°
Relative Phase (31.5 dB)	0.53	1.55	-2.42	-0.47	-0.17	-0.37	°
Input Return Loss	-18.7	-19.2	-19.7	-19.6	-19.3	-18.4	dB
Output Return Loss	-18.6	-19.1	-19.2	-18.4	-17.8	-17.0	dB
Input Power for 1dB Compression	17.2	26.8	29.8	30.6	30.6	30.5	dBm
Frequency	**2400**	**2800**	**3200**	**3600**	**4000**	**4400**	**MHz**
Reference State Insertion Loss	-2.0	-2.1	-2.2	-2.3	-2.2	-2.2	dB
Attenuation Accuracy (0.5dB)	0.01	-0.01	-0.01	-0.03	-0.04	-0.05	dB
Attenuation Accuracy (1 dB)	-0.02	-0.05	-0.06	-0.11	-0.13	-0.15	dB

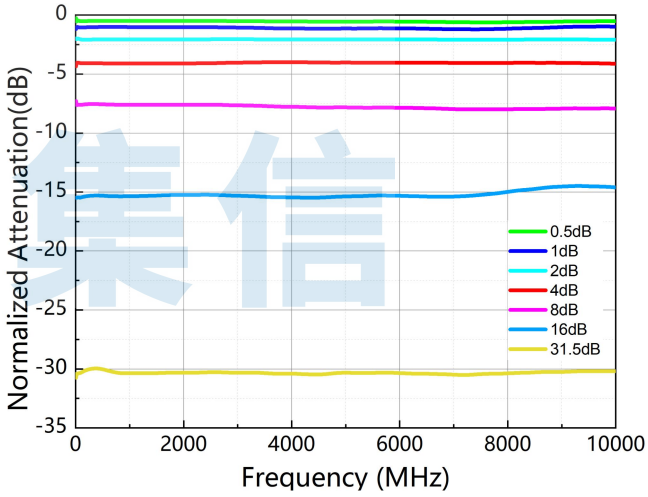
Attenuation Accuracy (2 dB)	-0.05	-0.05	-0.04	-0.06	-0.06	-0.07	dB
Attenuation Accuracy (4 dB)	-0.08	-0.04	-0.02	0.01	0.00	-0.01	dB
Attenuation Accuracy (8 dB)	0.39	0.37	0.33	0.27	0.22	0.18	dB
Attenuation Accuracy (16 dB)	0.77	0.72	0.67	0.57	0.55	0.53	dB
Attenuation Accuracy (31.5dB)	1.22	1.20	1.19	1.12	1.12	1.03	dB
Relative Phase (0.5dB)	-0.55	-0.72	-0.80	-0.95	-0.94	-0.96	°
Relative Phase (1 dB)	-0.65	-0.92	-0.93	-1.03	-0.86	-0.73	°
Relative Phase (2 dB)	-0.22	-0.40	-0.44	-0.61	-0.63	-0.65	°
Relative Phase (4 dB)	0.46	0.49	0.47	0.23	0.10	0.02	°
Relative Phase (8 dB)	-1.83	-2.38	-2.58	-2.99	-2.94	-3.01	°
Relative Phase (16 dB)	-0.11	-0.61	-0.53	-0.54	-0.13	0.43	°
Relative Phase (31.5 dB)	-0.58	-1.55	-1.54	-2.34	-2.57	-2.70	°
Input Return Loss	-17.2	-16.3	-15.7	-15.7	-16.1	-17.2	dB
Output Return Loss	-16.4	-15.9	-15.8	-16.3	-17.5	-19.2	dB
Input Power for 1dB Compression	30.1	30.6	30.6	30.3	30.5	30.4	dBm

Frequency	**5000**	**6000**	**7000**	**8000**	**9000**	**10000**	**MHz**
Reference State Insertion Loss	-2.4	-2.6	-2.7	-3.0	-3.2	-3.2	dB
Relative Phase (0.5dB)	-0.05	-0.05	-0.10	-0.11	-0.05	-0.02	dB
Relative Phase (1 dB)	-0.13	-0.13	-0.20	-0.15	-0.02	0.02	dB
Relative Phase (2 dB)	-0.06	-0.07	-0.09	-0.08	-0.07	-0.08	dB
Relative Phase (4 dB)	-0.02	-0.04	-0.05	-0.05	-0.05	-0.12	dB
Relative Phase (8 dB)	0.18	0.15	0.02	0.02	0.07	0.08	dB
Relative Phase (16 dB)	0.63	0.68	0.62	1.01	1.47	1.40	dB
Relative Phase (31.5dB)	1.19	1.16	1.03	1.13	1.24	1.32	dB

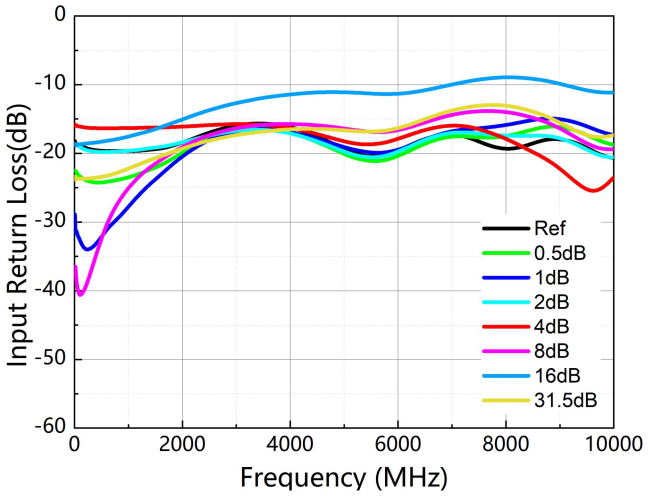
Relative Phase (0.5dB)	-0.92	-1.09	-1.20	-0.91	-0.96	-1.48	°
Relative Phase (1 dB)	-0.50	-0.48	-0.23	0.45	0.29	-0.45	°
Relative Phase (2 dB)	-0.54	-0.62	-0.75	-0.73	-1.03	-1.04	°
Relative Phase (4 dB)	0.09	0.15	0.03	-0.05	-0.46	-0.49	°
Relative Phase (8 dB)	-2.81	-3.13	-3.33	-3.10	-3.74	-4.35	°
Relative Phase (16 dB)	0.94	0.59	1.72	2.33	-0.69	-4.35	°
Relative Phase (31.5 dB)	-3.11	-5.32	-6.71	-8.60	-12.02	-15.95	°
Input Return Loss	-19.4	-19.6	-17.2	-19.4	-17.9	-20.7	dB
Output Return Loss	-22.7	-22.7	-19.9	-30.6	-24.0	-28.9	dB
Input Power for 1dB Compression	30.3	30.1	-	-	-	-	dBm
Switching Time	51ns rise switch			42ns down switch			ns
Test Conditions: Vdd=+5V, I=2mA, Temp=+25°C							



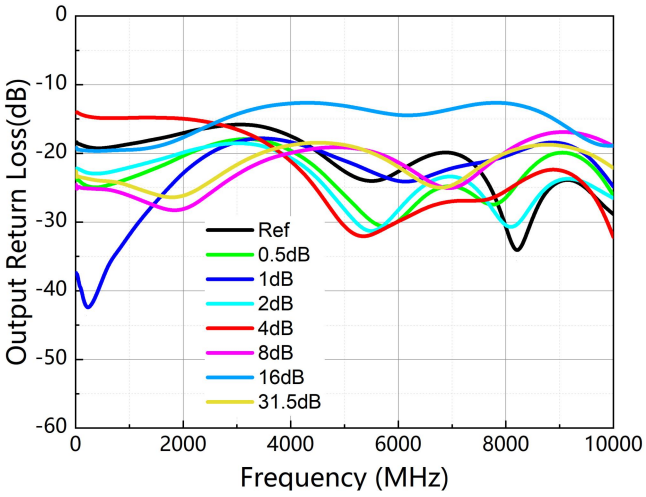
Insertion Loss vs. Freq.



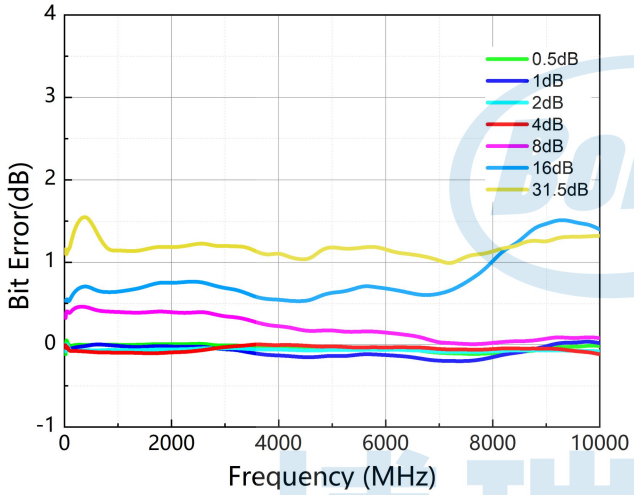
Normalized Attenuation vs. Freq.



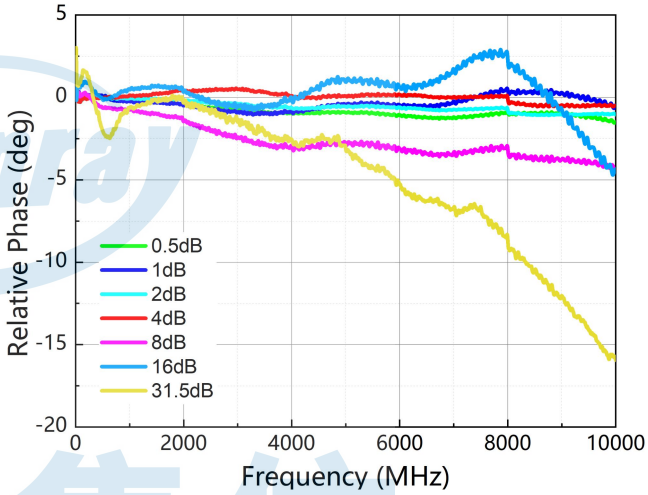
Input Return Loss vs. Freq.



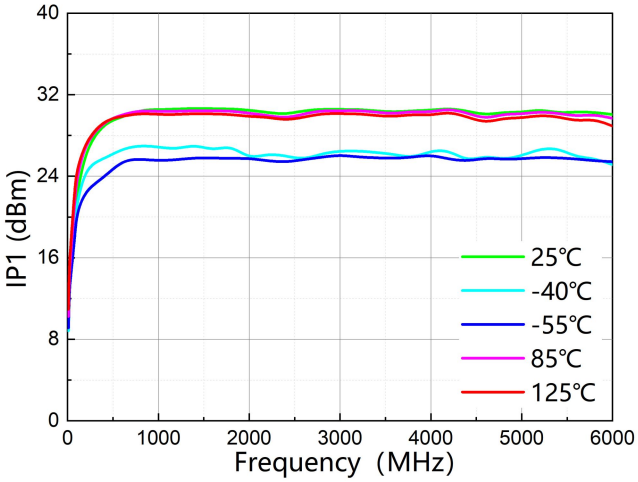
Output Return Loss vs. Freq.



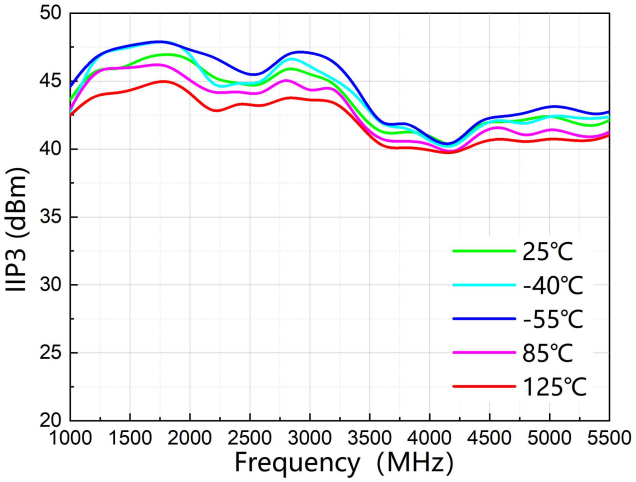
Bit Error vs. Freq.



Relative Phase vs. Freq.

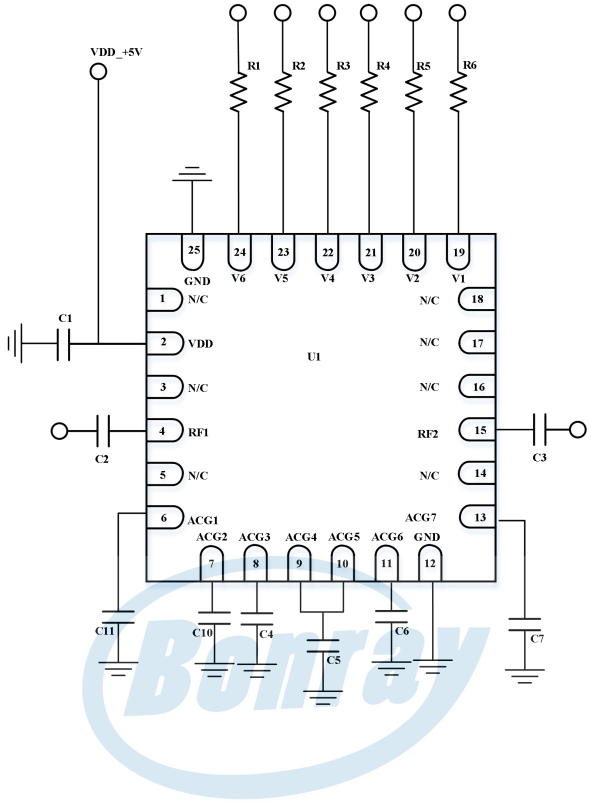


Input P1dB vs. Freq.



Input IP3 vs. Freq.

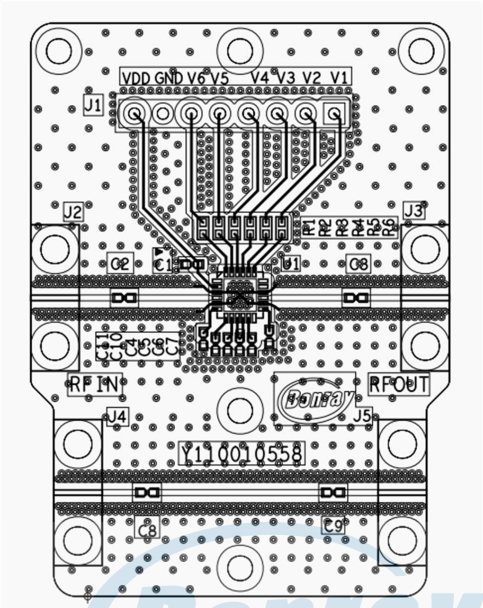
Typical Application Schematic

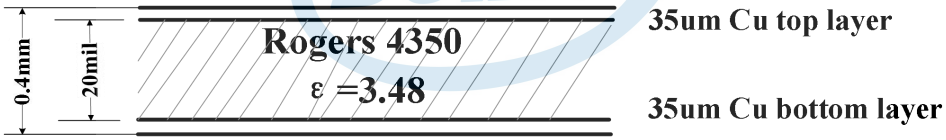


Bill of Material

Reference Designator	Package	Description	P/N
U1	QFN24	6-Bit Digital Attenuator	BR9363FPJ
C1	0402	1nF	GRM1555C1H102JA01D
C2, C3	0402	100nF	GRM155R71H104KE14D
C4, C5, C6, C7, C10, C11	0402	1uF	GCM155C71A105KE38D
R1~R6	0402	100 Ω	RC0402JR-07100RL

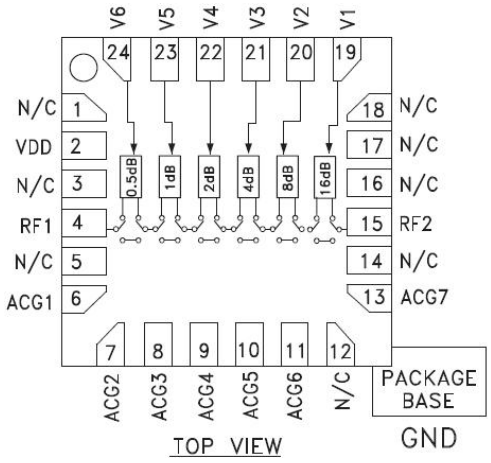
PCB Evaluation Board





50ohm transmission line:
width=0.53mm,spacing=0.65mm

Pin Configuration and Description



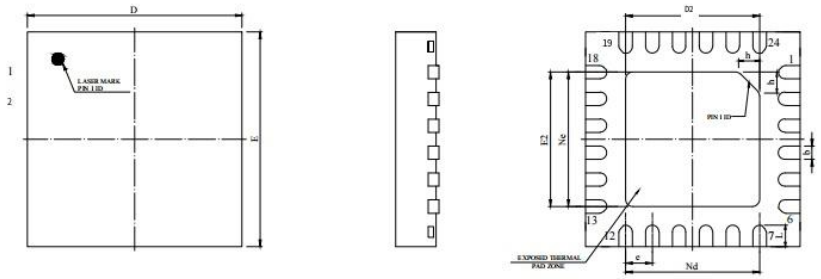
Pin Number	Pin Name	Description
1,3,5,12,16 ~18	NC	No electrical connection. These pins should be connected to ground
6 to 11, 13	ACG1~ ACG6	External capacitors to ground are recommended for low and high frequency operation. Select value for lowest frequency of operation. Place capacitor as close to pins as possible
2	VDD	Power supply pin.
4, 15	RF1, RF2	Attenuator RF input/output pins. DC block is required.
19 ~ 24	V1~V6	Parallel control voltage input pins. Select the required attenuation. See Truth Table.
-	PACKAGE BASE	Exposed pin. The exposed pad must be connected to RF/DC ground.

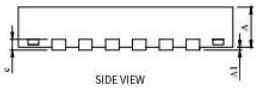
Control Voltage Truth Table

Control Voltage Input						Attenuation State
V1 16dB	V2 8dB	V3 4dB	V4 2dB	V5 1dB	V6 0.5 dB	RF1/RF2
0	0	0	0	0	0	Insertion loss in reference state
0	0	0	0	0	1	0.5 dB
0	0	0	0	1	0	1 dB
0	0	0	1	0	0	2 dB
0	0	1	0	0	0	4 dB
0	1	0	0	0	0	8 dB
1	0	0	0	0	0	16 dB
1	1	1	1	1	1	31.5dB

Note: Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

Package Dimensions (mm)





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.75	0.80	0.85
A1	0.01	0.02	0.05
b	0.20	0.25	0.30
c		0.270REF	
D	3.90	4.00	4.10
D2	2.60	2.70	2.80
e		0.50BSC	
Ne		2.50BSC	
Nd		2.50BSC	
E	3.90	4.00	4.10
E2	2.60	2.70	2.80
L	0.35	0.40	0.45
h	0.35	0.40	0.45